CLAIMS

1. In a plasma processing apparatus of an internal electrode type, which is provided with an inductive coupling type electrode in a vacuum processing chamber, the plasma processing apparatus characterized in that:

said electrode is formed so that a total length of said electrode is substantially equal to an excitation wavelength, one end of said electrode is grounded and another end thereof is connected to a high frequency power source, and a standing wave of one wavelength is produced along said electrode when said high frequency power source supplies a high frequency power to said electrode; and

a node of said standing wave produced along said electrode is formed at a central portion of said electrode, and an antinode of said standing wave is formed on both portions respectively corresponding to a half of said electrode, which existing at both sides of said center point.

2. A plasma processing apparatus of an internal electrode type as set forth in claim 1, characterized in that said electrode is formed to be U-shaped by bending it back at said central portion, and each of the half portions of said electrode corresponds to a straight portion, and both of the half portions are arranged in parallel.

3. A plasma processing apparatus of an internal electrode type as set forth in claim 1, characterized in that a length of the half portion of said electrode is substantially equal to a

half of the wavelength of said high frequency power.

4. A plasma processing apparatus of an internal electrode type as set forth in claim 1, characterized in that a plurality of said electrodes are arranged to make a stratified structure comprising a plurality of layers within said vacuum processing chamber, a plurality of film depositing regions are produced using a space between said electrodes included in said plurality of layers, and film deposition on a substrate is performed in each of said plurality of film depositing regions.

5. In a plasma processing apparatus of an internal electrode type, which is provided with an inductive coupling type electrode in a vacuum processing chamber, the plasma processing apparatus characterized in that:

said electrode is formed so that a total length of said electrode is determined to natural number times of a half of an excitation wavelength, one end of said electrode is grounded and another end thereof is connected to a high frequency power source, and standing waves are produced along said electrode when said high frequency power source supplies a high frequency to said electrode; and

a node of said standing waves produced along said electrode is formed at a central portion of said electrode, and at least one antinode of said standing waves is formed on both portions respectively corresponding to a half of said electrode, which existing at both sides of said center point.

6. A plasma processing apparatus of an internal electrode type as set forth in claim 5, characterized in that said electrode

is formed to be U-shaped by bending it back at said central portion, and each of the half portions of said electrode is a straight portion, both of the half portions are arranged in parallel, and said node of said standing wave is consistent with a bending back point.

7. A plasma processing apparatus of an internal electrode type as set forth in claim 5, characterized in that a plurality of said electrodes are arranged to make a stratified structure comprising a plurality of layers within said vacuum processing chamber, a plurality of film depositing regions are produced using a space between said electrodes included in said plurality of layers, and film deposition on a substrate is performed in each of said plurality of film depositing regions.

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8. A plasma processing apparatus of an internal electrode type, characterized by:

comprising a plurality of electrodes of an inductive coupling type in a vacuum processing chamber; wherein

each of said plurality of electrodes is formed by bending back a conductor at its central portion to be U-shaped, a straight portions formed by said bending back are parallel and are arranged to be in one plane and further one end of each of said electrodes is grounded and another end thereof is connected to a high frequency power source,

said plurality of electrodes having a positional parallel relationship are placed so that a straight portion at a power supplying side is adjacent to a straight portion at a grounded side,

high frequency powers respectively supplied into end of said straight portions of power supplying side for said plurality of electrodes are in phase.

9. A plasma processing apparatus of an internal electrode type as set forth in claim 8, characterized in that a length of the straight portion formed by bending back in the plurality of electrodes is determined to produce an antinode of a standing wave on said straight portion.

10. A plasma processing apparatus of an internal electrode type as set forth in claim 9, characterized in that some of said electrodes arranged to be in one plane is configured as an electrode array, a plurality of the electrode arrays are placed as a stratified structure within said vacuum processing chamber, a plurality of film depositing regions are produced using a space between said electrode arrays of plural layers, and film deposition on a substrate is performed in each of said plurality of film depositing regions.

11. A plasma processing apparatus of an internal electrode type, characterized by:

comprising a electrodes of an inductive coupling type in a vacuum processing chamber; wherein

said electrodes is formed by bending back a conductor at its central portion to be U-shaped,

a plasma discharge is produced around said electrode by supplying a high frequency power to an end of said electrode so that a standing wave of half wavelength is produced at a straight portion formed by bending back said electrode, and

frequency (f) of said high frequency power at this time is determined by

$$f=(c/\sqrt{\varepsilon_p})/2L1$$

where c is the speed of light, L1 is the length of the straight portion formed by bending back said electrode, and ε_p is the relative dielectric constant of plasma produced around said electrode.

12. A plasma processing apparatus of an internal electrode type as set forth in claim 11, characterized in that the frequency of said high frequency power is changed according to plasma parameters around said electrode.

13. A plasma processing apparatus of an internal electrode type as set forth in claim 11, characterized in that a plasma CVD processing is performed for depositing a film with a solar cell function on a large area substrate within said vacuum processing chamber.

14. A plasma processing apparatus of an internal electrode type as set forth in claim 11, characterized in that said length L1 of said electrode is more than 0.8 meter.

15. In a plasma processing apparatus having an electrode of an inductive coupling type placed within a vacuum processing chamber, a plasma processing method characterized in that:

said electrode is formed by bending back a conductor at its central portion, a total length of said electrode is determined to be a natural number times of a half of an excitation wavelength, a high frequency power is supplied to end of said electrode, a node of a standing wave produced in said electrode

is consistent with a bending back point, an antinode of said standing wave is produced in each half portion of said electrode, and said standing wave makes density distribution of plasma around said electrode to be uniform.

16. A plasma processing method as set forth in claim 15, characterizing in that the total length of said electrode is twice as long as a half of an excitation wavelength.

17. In a plasma processing apparatus comprising an electrodes of an inductive coupling type in a vacuum processing chamber, a plasma processing method characterized in that:

said electrodes is formed by bending back a conductor at its central portion to be U-shaped,

a plasma discharge is produced around said electrode by supplying a high frequency power to an end of said electrode so that a standing wave of half wavelength is produced at a straight portion formed by bending back said electrode, and

frequency (f) of said high frequency power at this time is determined by

$$f=(c/\sqrt{\varepsilon_p})/2L1$$

where c is the speed of light, L1 is the length of the straight portion formed by bending back said electrode, and ε_p is the relative dielectric constant of plasma produced around said electrode.

18. A plasma processing method as set forth in claim 17, characterized in that the frequency of said high frequency power is changed according to plasma parameters around said electrode.